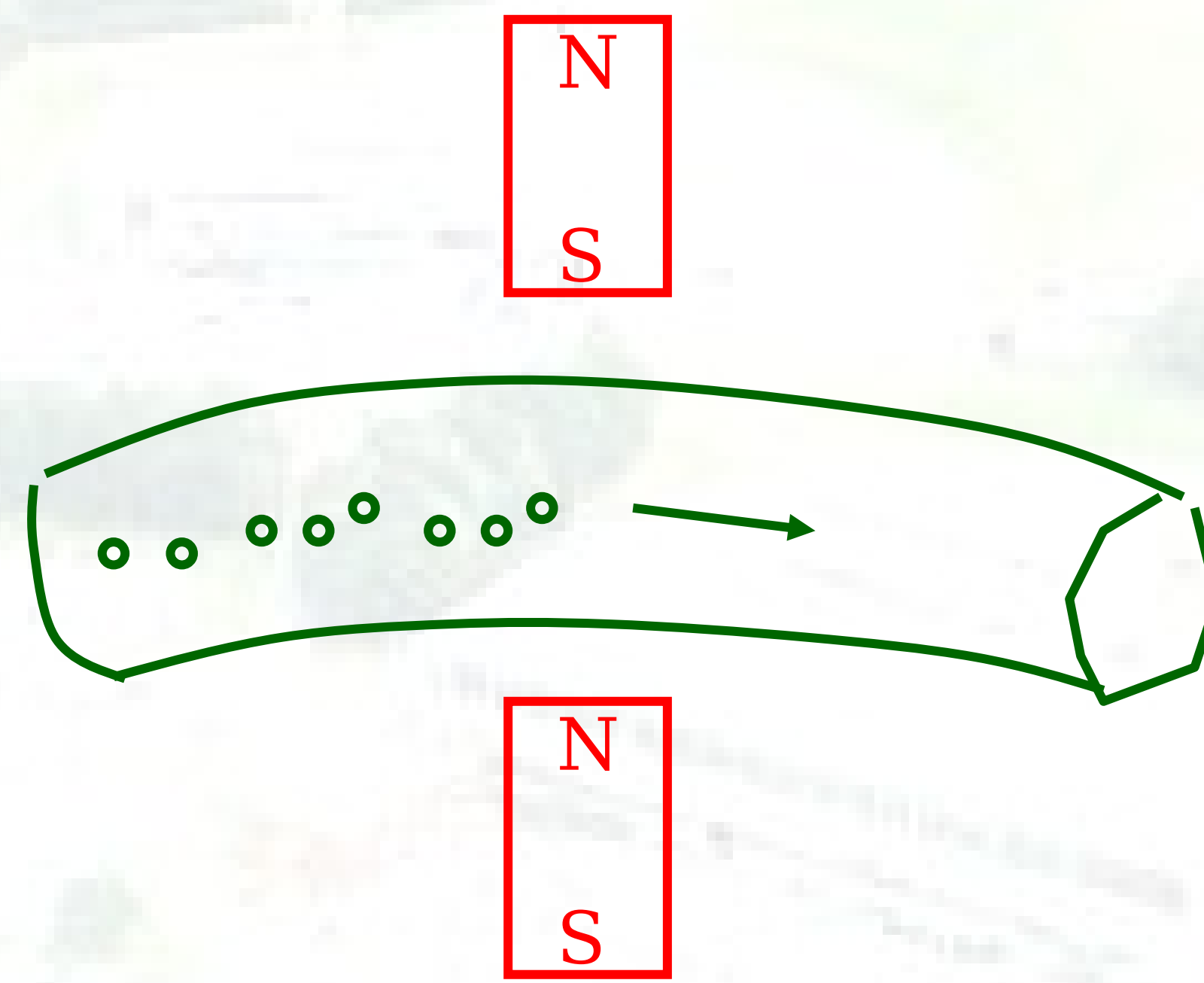
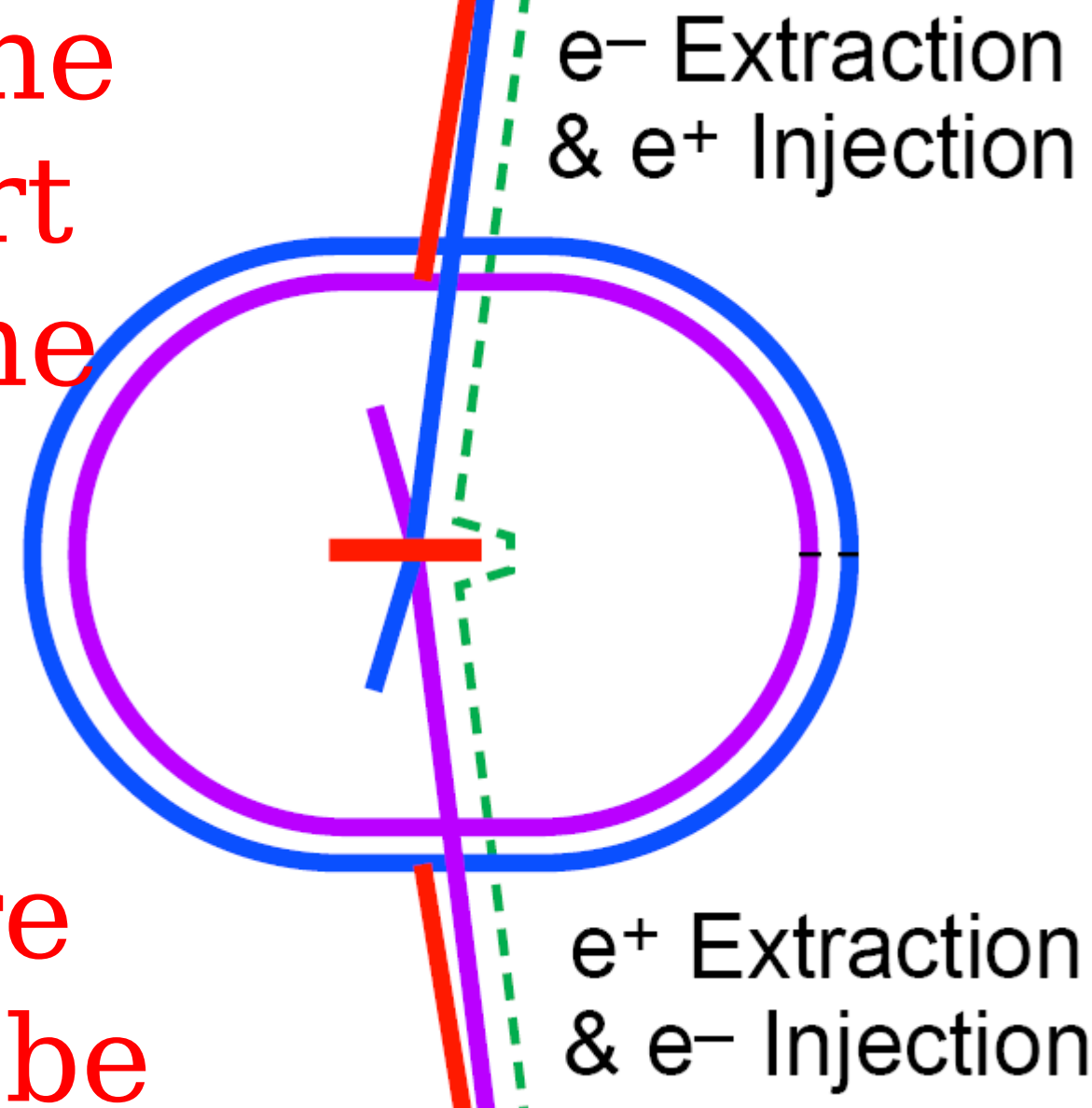


The purpose of a damping ring is to reduce the width of a beam of electrons or positrons. Then they will be extracted and speeded up to very high energy by an

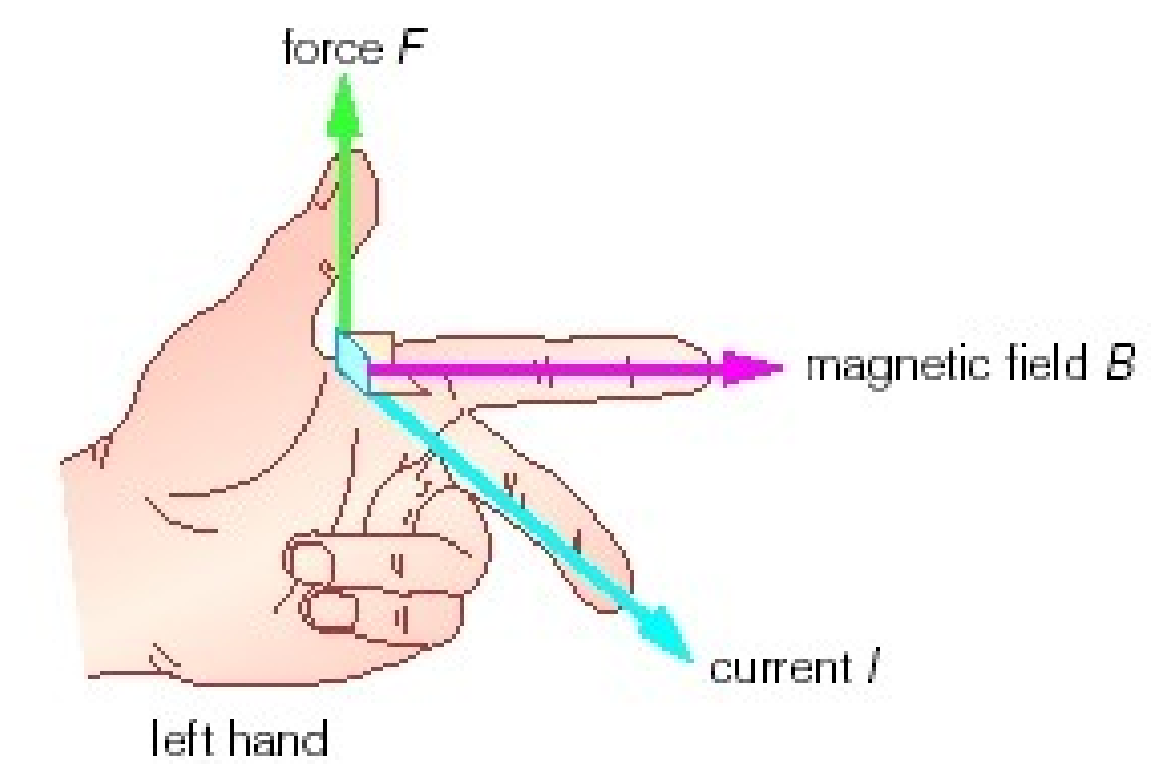
At the heart of the ILC

there will be two rings.

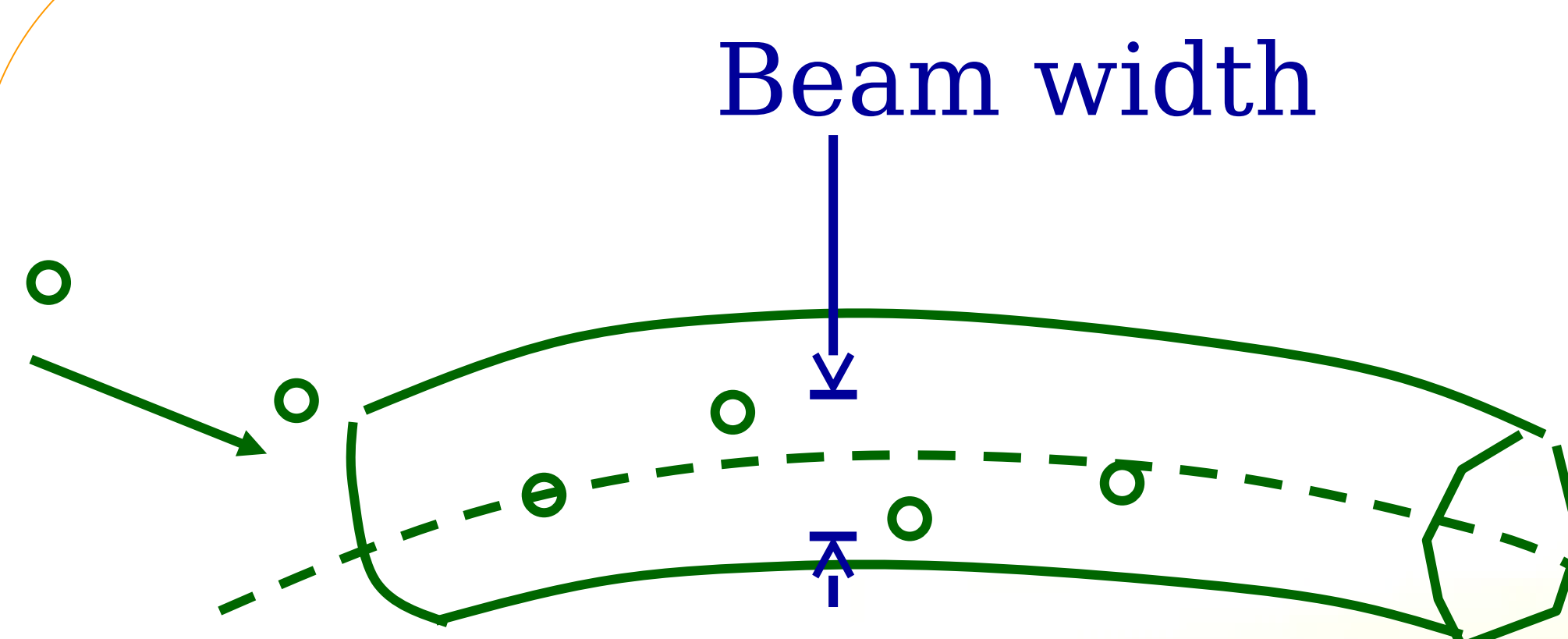
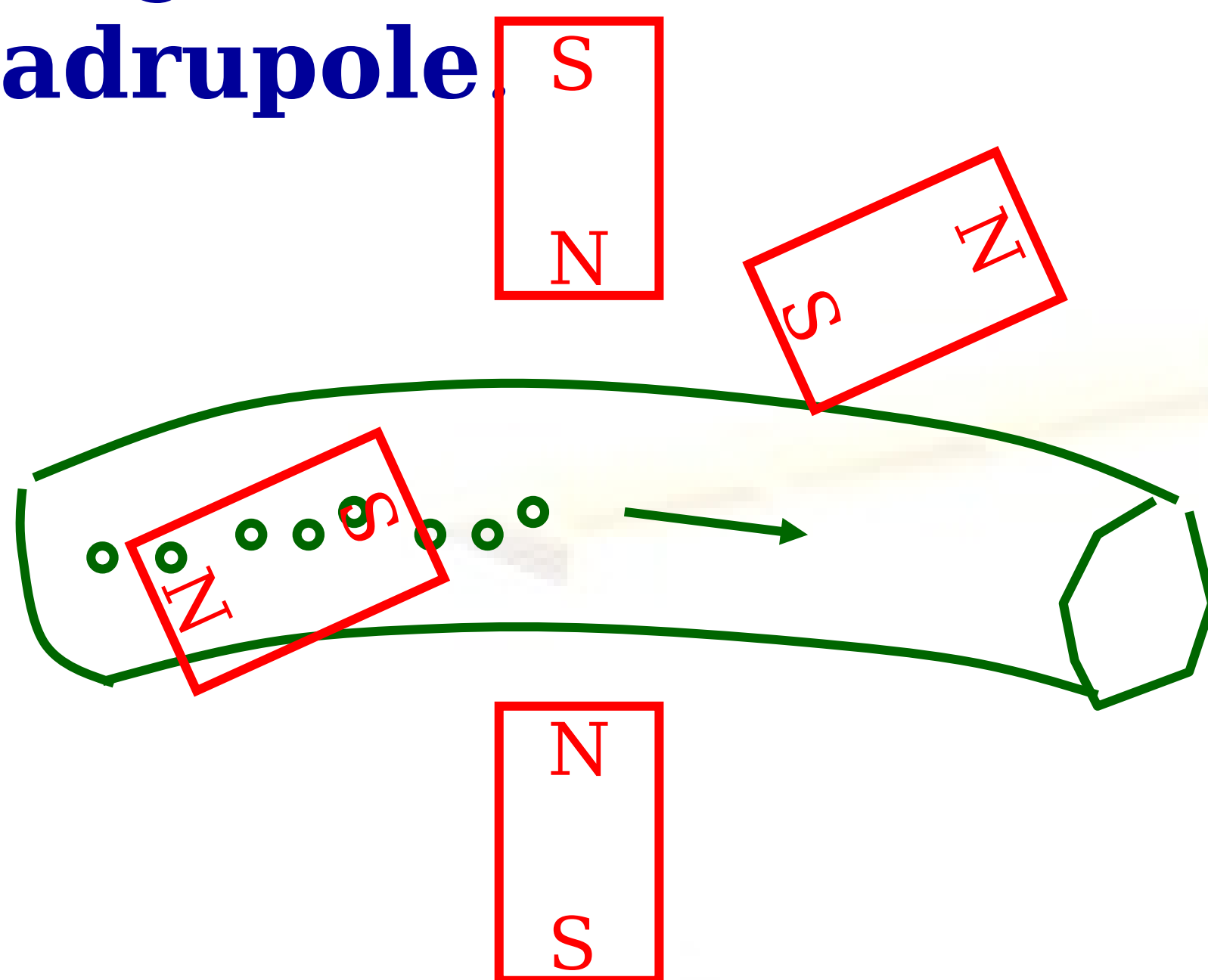


Each ring is made up of a hollow Aluminium pipe that is about 6.7 km long. There must be a very good vacuum inside, or else the electron beam would run into air molecules.

Magnets are used to make the electrons go round in a circle. These are called **bending magnets**. When the electrons feel the magnetic field, they would experience a force.

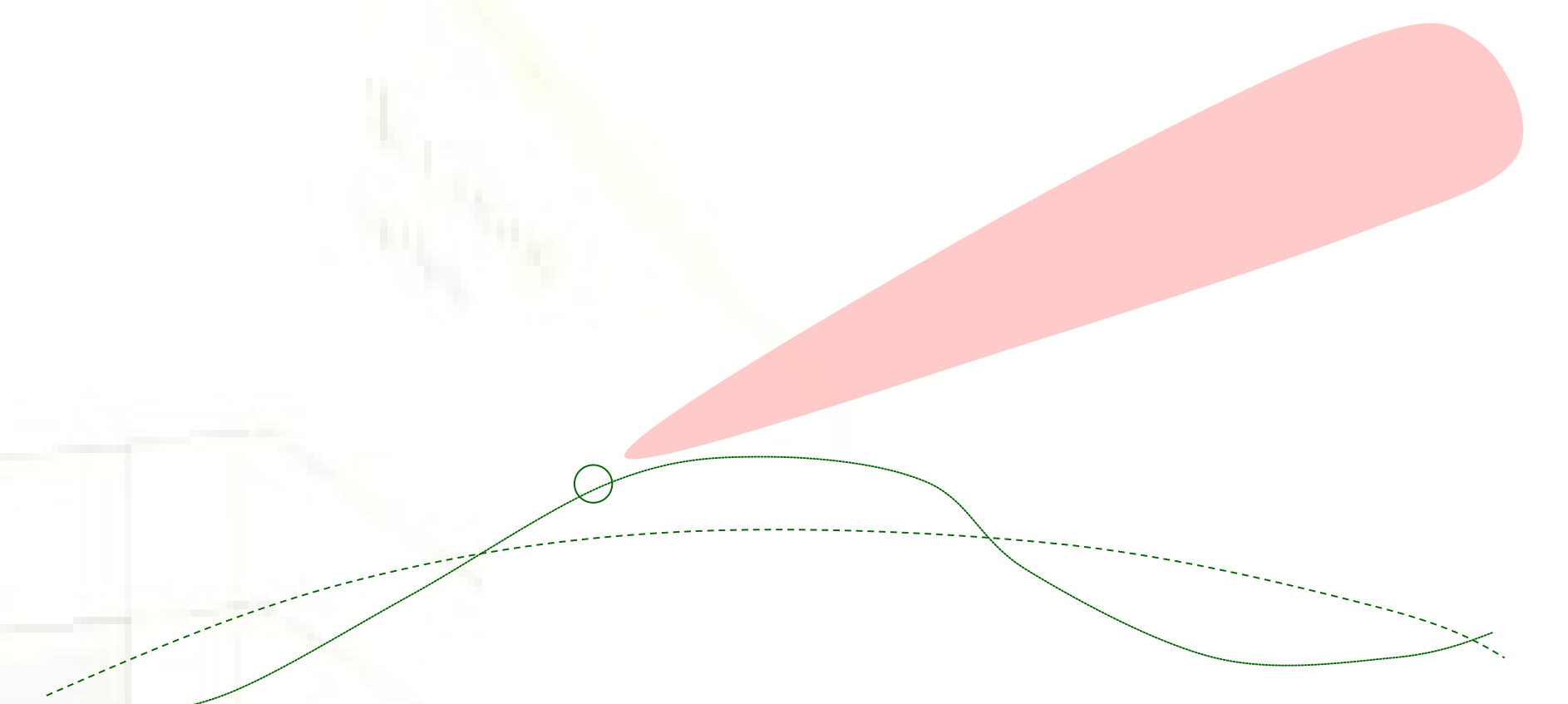


A clever arrangement of four magnets provides a force that moves the electrons towards the axis of the pipe. This set of magnets is called a **quadrupole**

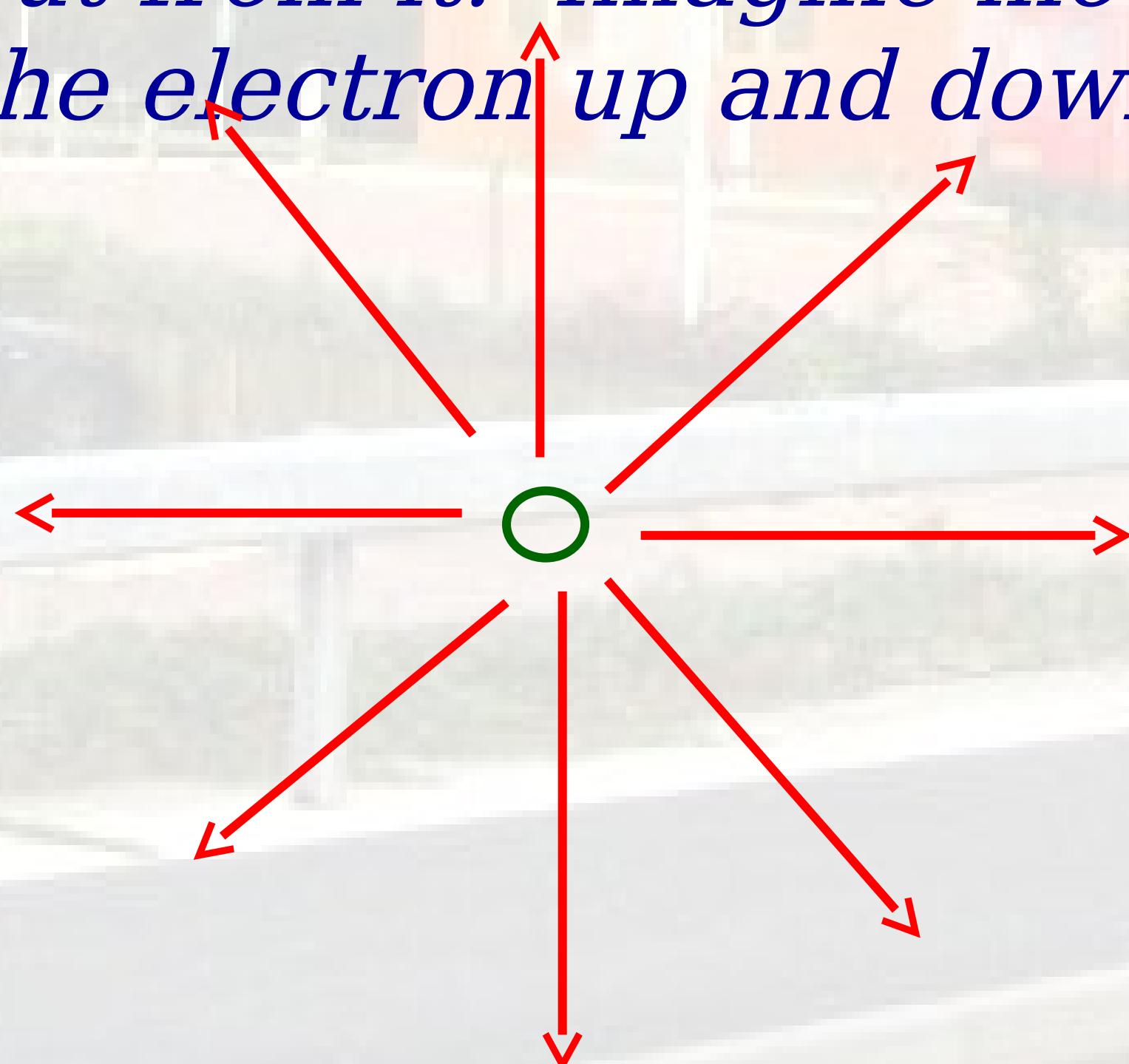


Unfortunately, when electrons are first injected into the pipe, they do not fall exactly on the axis. So they oscillate about the axis. This is called **betatron oscillation**. The amplitude is the beam width.

When the bending magnet pushes the electron sideways, the electron emits radiation. The radiation energy comes from the kinetic energy of the electrons. This reduces the oscillation.



Why does the electron emit radiation? Think of an electron at rest, and think of the electric field lines coming out from it. Imagine moving the electron up and down.



Microwave
Infrared
Ultraviolet
X rays



When you shake a string, you create a wave. When you shake the electric field, you create an electromagnetic wave. This is the radiation given out. It is called **synchrotron radiation**.

If you are very good and make sure that the thousands of magnets are all perfectly aligned, the oscillation will drop to a few micrometers. This what **damping** means. Then everyone will be happy.

